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February 6, 1995

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FEDERAL COMMUNICATIONS COMMISSION
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Mr. William F. Caton, Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

DOCKET FILE COPY ORIGINAL

In re: PR Docket No. 92-235
The Ericsson Corporation
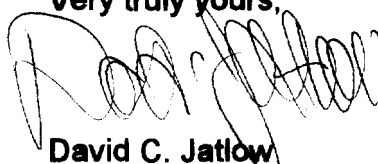Written Ex Parte Communication

Dear Mr. Caton:

Pursuant to the provisions of Section 1.1206 of the Commission's rules, please be advised that on February 6, 1995, representatives of The Ericsson Corporation, and affiliates thereof, met with representatives of the Private Radio Bureau, Office of Plans and Policy and Office of Engineering and Technology, to discuss issues related to the above-referenced proceeding.

The attached document was submitted to all FCC personnel who attended the meeting in question.

An original and one copy of the formal written materials is being submitted herewith for inclusion in the record of this proceeding.

Should there be any questions with regard to this matter, kindly communicate directly with the undersigned.

Very truly yours,

David C. Jatlow
Counsel for The Ericsson Corporation

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ERICSSON ≋

ERICSSON RECOMMENDED EMISSION MASKS

Summary

One of the issues addressed in PR Docket No. 92-235 is the development of a suitable emission mask to be included in proposed Part 88 of the Commission's rules. Any changes in emission masks must take into account the fact that different modulation types (DQPSK, QPSK-C, LM, 16QAM, etc.), are currently employed or are feasible in land mobile radio equipment. Thus any changes in emission mask rules should also permit deployment of new emission technologies to the extent possible.

On May 28, 1993 and June 20, 1993, The Ericsson Corporation ("TEC") submitted comments and reply comments, respectively, in the Notice of Proposed Rulemaking in PR Docket No. 92-235. In the 19 months since comments in this proceeding were filed with the Commission, Ericsson has performed extensive research and product development for new generations of equipment that will be affected by the proposed mask changes. As a result of its efforts Ericsson has developed emission masks which can accommodate many different technologies. Rather than being technology limiting, the masks Ericsson describes below will enable numerous analog and digital modulation schemes to be deployed and still meet the Commission's goals. Adoption of these emission masks will result in a wider variety of products being deployed, resulting in greater competition in the equipment marketplace which will ultimately inure to the benefit of end users.

Finally, Ericsson submits that moving directly from 25/30 kHz channels to 6.25 kHz or 6.25 kHz equivalent efficiency channels in all of the bands under consideration will allow spectrum to be used more efficiently; will make refarming economically more viable; and will minimize disruption to service providers and end users alike. However, to the extent the Commission adopts rules that require refarming to occur in two steps, Ericsson has also provided a recommendation for a mask for 12.5 kHz channels. This mask is also described below.

Side Band Spectrum Measurement Recommendation

The purpose of emission masks is to limit the interference to receivers operating in spectrum removed from the operating frequency. This is normally achieved by (a) specifying the transmitter channel parameters (power, bandwidth and emission) and (b) by equipment approval requirements, the power permitted outside the authorized bandwidth.

Due to equipment design, measurement, tuning and operating environments, it is difficult to set and maintain the exact amount of power to be permitted outside the operating channel bandwidth. Therefore, the power permitted outside the authorized channel is usually specified as a ratio of desired to undesired power which is usually called the adjacent channel power ratio or the adjacent power interference protection ratio. Depending on the reference document, this ratio may be identified as ACP, ACPR or ACIPR.

Performance Criterion

In developing the following emission masks, Ericsson established a method of comparing different mask specifications to obtain a true indication of the adjacent channel interference caused by the transmission of the desired channel. For the purpose of this evaluation, the TIA standard definition of adjacent channel power ratio[1] was used because it is accepted and supported by multiple manufacturers and is recognized by international standards bodies as an appropriate criterion.

By definition, the adjacent channel power ratio times the received power provides the adjacent channel power level. Because the selectivity characteristics of the measuring receiver affect the measured signal level, it is also necessary to specify the receiver intermediate frequency (IF) filter characteristics. These are also found in EIA/TIA 603[2].

The ACP is further defined by the formula

$$ACP = [\int_{adj} S(f)df \, |H(f)|^2] \, / \int_{on} S(f)df$$

where $S(f)$ is the transmitted signal power spectral density and $H(f)$ is the IF filter attenuation characteristic[3] of the power measuring receiver centered at the adjacent channel.

A computer program was written to compute the ACP for different masks. Two assumptions were made in the computation:

1. the transmitted spectrum that spreads into the adjacent channel is identical to the emission mask and;

2. the IF filter of the measuring receiver matches that specified in EIA/TIA 603.

The first assumption represents the worst case transmission, regardless of the type of modulation or the shape of the spectrum main lobe. The second assumption is based on EIA/TIA 603 measurement methods. Since many new receivers utilize narrower IF filters, it also represents a worst-case scenario.

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[1] "The adjacent channel power ratio is that part of the total output power of a transmitter under defined conditions and modulation, which falls within a specified passband centered on the nominal frequency of either of the adjacent channels." Section 2.2.14.1, Page 74, EIA/TIA 603, Telecommunications Industry Association, Washington, D.C., 1992

[2] Section 1.5.8, Page 21-23, EIA/TIA 603, Telecommunications Industry Association, Washington, DC

[3] Ibid.

Therefore, with the same IF filter specification, the worst case ACP provided by different masks can be calculated. Additionally, if the mask is normalized by assuming a 1 Watt on channel signal, the denominator term $\int_{on} S\,(f)df = 1$,

and the formula then simplifies to:

$$\int_{adj} (M(f)\,/\,BW_{res}) \,|\,H(f)\,|^2 df \approx ACP$$

where $M(f)$ is the mask function and BW_{res} is the resolution bandwidth for that mask function.

Recommended emission mask for 12.5 kHz channels:

Proposed Sideband Spectral Mask
12.5 kHz Channels
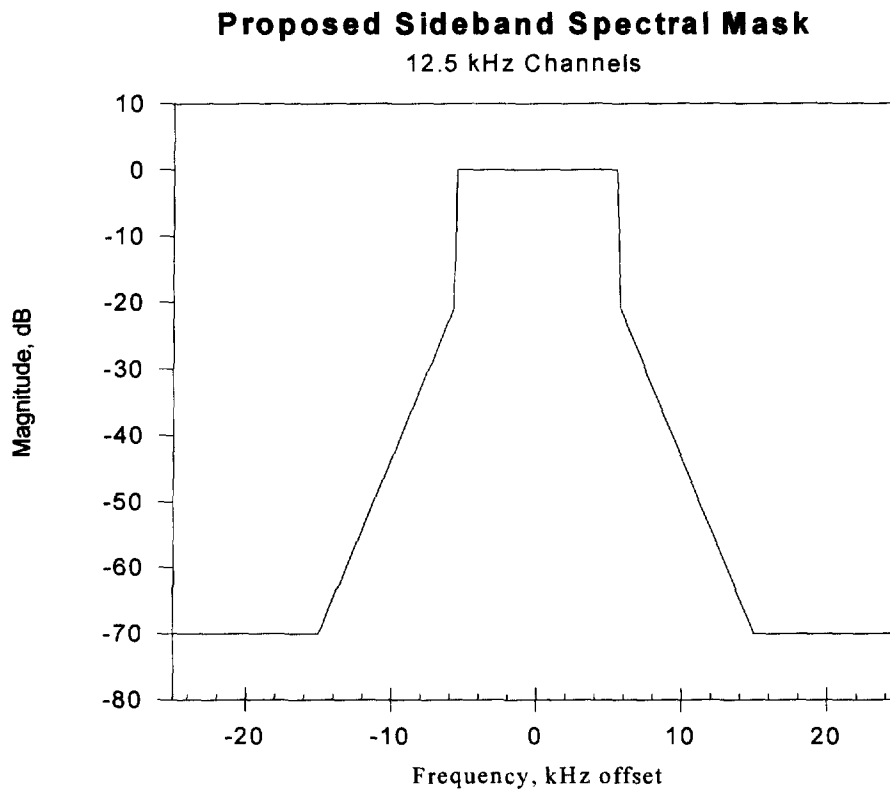
Displacement Frequency (f_d)	Attenuation (dB)
0 kHz to 5.625 kHz	0
5.625 kHz < f_d <15 kHz	$5.3(f_d$-1.8 kHz)
15 kHz < f_d	50 + 10log_{10}(RFOP), or 70 whichever is smaller

Recommended emission mask for 25 kHz channels:

Proposed Sideband Spectral Mask
25 kHz Channels

Frequency, kHz offset
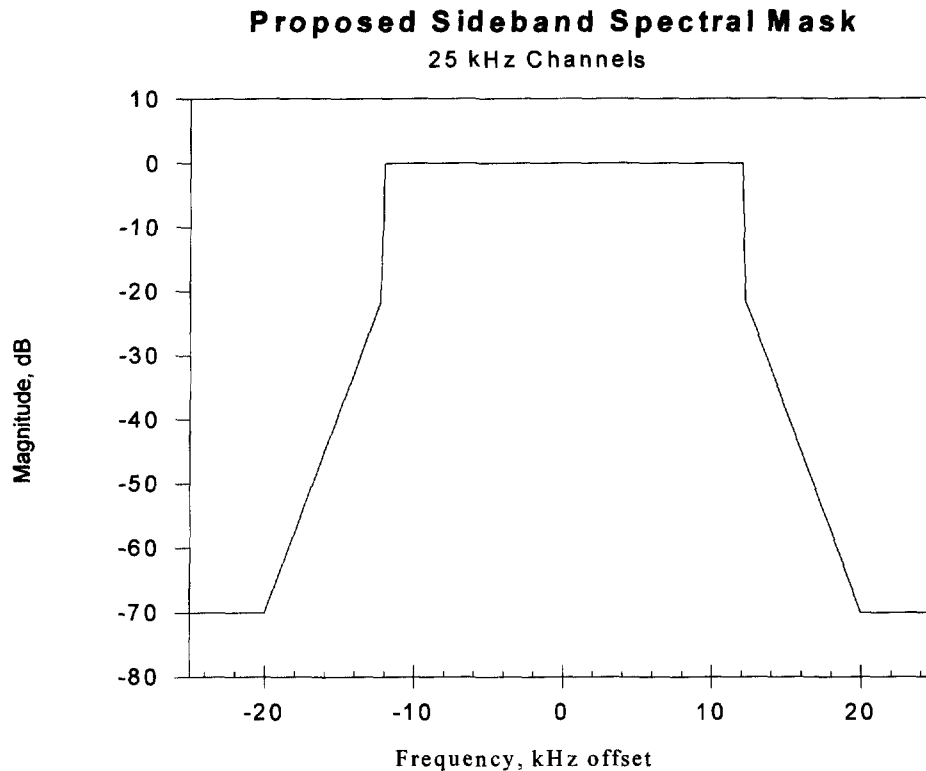
Displacement Frequency (f_d)	Attenuation (dB)
0 kHz to 12 kHz	0
12 kHz < f_d <20 kHz	$6.25(f_d\text{-}8.8\ kHz)$
20 kHz < f_d	$50 + 10log_{10}(RFOP)$, or 70 whichever is smaller

Calculations of worst case adjacent channel power from the above graphs and plots were performed to provide comparisons to the values calculated according to Section 90.209 of the FCC rules.

The calculations demonstrate a compelling reason to accept Ericsson's recommendations for a number of reasons. First, the masks offer significantly more flexibility within the authorized emission bandwidth to implement different types of modulation and will be more conducive to good spectrum management than those modulation forms currently under consideration or in service for mobile use. Second, and more importantly, the proposed masks do not restrict innovation within the authorized bandwidth.

The calculations and their comparisons at the various specified characteristics of Section 90.209 of the FCC rules are presented in Table 3 for 12.5 kHz, in Table 4 for 25 kHz and in Table 5 for power in-band. These charts indicate that the masks produce significantly less power in the adjacent channel than do the current FCC rules. At the same time the masks offer improved power capabilities in the assigned channels. Table 6 compares the 12.5 KHz mask submitted by the TIA in its Refarming Comments to the mask proposed by Ericsson. Notably, the TIA mask fits within the Ericsson proposal which will allow for greater competition within the land mobile radio equipment marketplace. Table 7 compares the Part 88 proposal for 800 MHz to the Ericsson recommendation.

Conclusion

One thing that is known is that all possible forms of modulation have not yet been discovered and perfected. Ericsson believes that an emission mask offering no attenuation within the authorized bandwidth is far preferable and more stimulating to innovation than one whose parameters permit only a select few modulation types.

For the reasons stated above, Ericsson strongly advocates that the Commission adopt its recommended masks that will allow for different modulation types currently employed and permit deployment of new emissions technologies in the future.

Table 3
12.5 KHz Emission Masks
(All Values Rounded to Nearest 0.1dB)

% Authorized Maximum Emission Bandwidth (13 6 KHz) per (90 209(b)(5))	Ericsson Recommendation	Analog 90 209 (c)(2)	Digital 90 209 (h)
0% (0 KHz)	0dB	0dB	0dB
2.5 KHz	0dB	0dB	0dB
25% (3.4 KHZ)	0dB	0dB	7 1dB
6.25 KHz Channel Edge	0dB	0dB	21 1dB
50% (6.8 KHz)	26 5dB	25dB	24 9dB
9.0 KHz	38 2dB	35dB	37 4dB
9.5 KHz	40 8dB	35dB	39 8dB
12.5 KHz	56 7dB	35dB	58 5dB
15 KHz	70dB	70dB	70dB

Table 4
25 KHz Emission Masks
(All Values Rounded to Nearest 0.1dB)

% Authorized Emission Bandwidth 20 KHz	Ericsson Recommendation	Analog 25 800 MHz	Digital 450-800MHz 90 209(g)
0% (0 KHz)	0dB	0dB	0dB
25% (5 KHz)	0dB	0dB	0dB
50% (10 KHZ)	0dB	25dB	25dB
62.5% Channel Edge (12.5 KHz)	23 1dB	25dB	36 1dB
100% (20 KHz)	70dB	25dB	59.8dB
125% (25 KHz)	70dB	35dB	70dB

Table 5
Transmit Adjacent Channel Power Ratio

	Ericsson Recommendations	90 209(g)	90 209(h)
12.5 KHz Channels	30 5dB	--	-29 6dB
25.0 KHz Channels	-46 8dB	-35 5dB	--

*Notes: 1)Calculations performed per formulas in text.
2)Calculated worst case ACPR

6

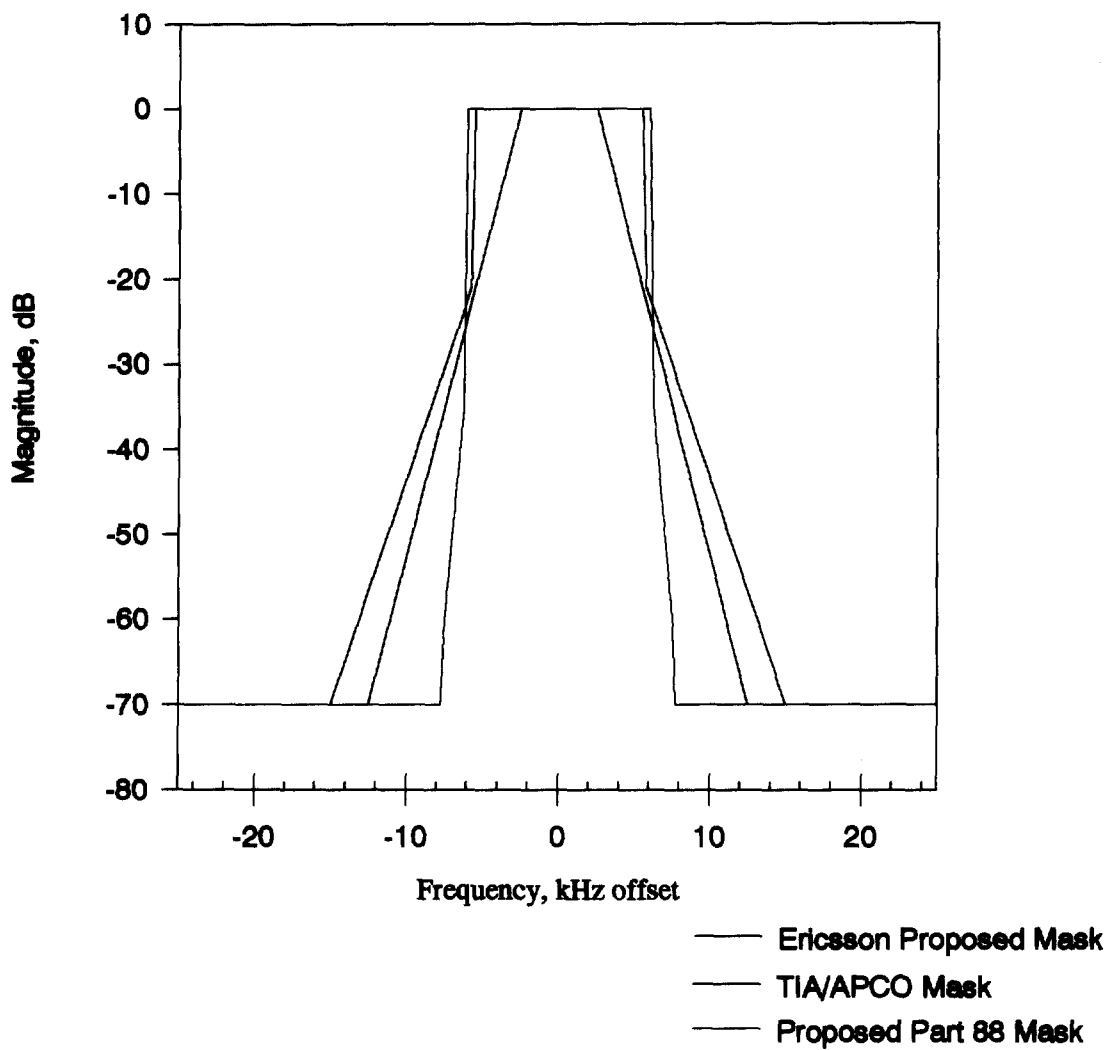Table 6

Mask Comparison

12.5 kHz Channels, UHF/VHF

Magnitude, dB

10

0

-10

-20

-30

-40

-50

-60

-70

-80

-20   -10   0   10   20

Frequency, kHz offset

—— Ericsson Proposed Mask

—— TIA/APCO Mask

—— Proposed Part 88 Mask

Table 7

Mask Comparison
25 kHz Channels, 800 MHz

Frequency, kHz offset

—— Part 88 Proposal
—— Ericsson Proposal